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AN EVALUATION OF AERIAL PHOTOGRAPHY AS A METHOD OF DETECTION OF PITCH CANKER

By

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Introduction:

Pitch canker, a disease destructive to many species of pine, was first reported by Hepting and Roth in 1946.

Since 1969 severe damage has occurred on slash pine, *Pinus elliottii* Engelm., in Forida because of pitch canker. The primary symptom of this disease is a sunken face canker which exudes large amounts of resin. The canker may eventually girdle the tree or cause branch killing. Where dieback is occurring (either of the whole tree or of the branches) there is visible flagging. Severely infected trees may be killed within a single season while less severely infected trees often recover leaving only a crooked bole or a few dead branches. There is no known control for this disease.

Ground surveys have been made in an attempt to interpret both the current status and the future potential for damage by pitch canker. Ground detection surveys, while effective in special situations, are not cost efficient over large areas.

Aerial photography offers an alternate method for pitch canker detection. However, previous attempts at aerial photography for pitch canker detection (all unreported) have failed. Problems encountered in these prior attempts include image motion in the photography; background litter confused with

dead branches (in non-stereo photos); and new growth masking the recently killed terminal branch(es).

Taking large scale photography, stereo pairs of photographs, and timing the photography to coincide with maximum symptom expression prior to spring growth (early to mid March) should alleviate most of the problems which have been encountered during early trials.

Methods and Materials:

In an effort to quantify the losses resulting from pitch canker personnel of the Hudson Pulp and Paper Company, Woodlands Division (Palatka, Florida) established thirty three, one hundred tree, permanent plots. These plots, located in Volusia and Flagler Counties, Florida were set up in plantations of slash pine. With the cooperation of Mr. Earl Underhill these plots were made available to us.

Flagging, approximately 18" x 60", was set in the crowns of the four corner trees of each plot. Aerial photography was taken using a Wild-Heerbrugg RC-10 camera and Kodak aerocolor transparency film (Kodak #2445). Photographs were taken at a scale of 1:2000 (6" lens @ 1000' altitude). After processing, the plots were located on the photographs using the four flagged corners and an evaluation of the damage to the trees was made.

Ground checks were made on all plots to record accurate ground truth data. Data recorded on the ground was to be compared with photo-interpretation data to evaluate the accuracy of photo detection.

A second series of aerial photographs was taken. These were made using Kodak Aerochrome infra red transparency film (Kodak #2443). This photography is at a scale of 1:3400. An evaluation of the utility of this photography was made.

Results:

A summary of the ground truth data is presented as Table 1. It is obvious that there was a very high healthy/diseased tree ratio (ca 4:1) in an area which had previously been heavily damaged by pitch canker. In fact, only nine percent of the trees in the plots showed damage on more than the terminal plus three lateral branches. Branch flagging alone was observed in 5% of the trees. Off color needles were encountered, but even from the ground observations this was rarely attributed to pitch canker. The single most consistent symptom observed was persistent grey needles clustered at the tips of dead branches.

The interpreter's ability to evaluate the aerial photography was severely limited by the resolution of the photos. Where branches with red terminals occurred on the side of the tree towards the camera lens or on the top of the crown, it could sometimes be identified in the photos. Where flagging was not present (symptoms limited to old, grey needled dead branches) identification was virtually impossible. The photographic definition of single branches at a scale of 1:2000 was unsatisfactory. A slight amount of image motion plus the small size of the single branches combined to mask them from the photo interpreter.

A further problem was encountered. Parallax between the 1:2000 stereo pairs was too great to allow satisfactory interpretation of the photography.

Photo imagery at 1:3400 scale did not suffer from the parallax problem encountered at 1:2000 nor was the problem of image motion serious at this scale. Unfortunately, the reduction of actual image size increased the

Plot Number	NUMBER OF TREES IN EACH INFECTION CLASS							
	1	2	3	4	5	6	7	Total
1	99	0	0	0	1	0	0	100
2	41	7	8	11	9	9	14	99
3	83	0	6	1	3	6	1	100
4	98	0	0	1	0	0	0	99
5	57	11	4	7	7	9	2	97
6	67	5	4	6	6	1	7	96
7	93	1	0	2	2	0	2	100
8	59	4	8	12	13	3	0	99
9	79	1	4	7	5	4	0	100
10	89	1	4	2	2	1	1	100
11	Data Sheet missing							
12	97	0	1	2	0	0	0	100
13	60	5	10	9	4	5	7	100
14	77	7	7	3	2	3	1	100
15	99	0	0	0	0	0	0	99
16	97	3	0	0	0	0	0	100
17	56	8	6	7	13	6	2	98
18	86	10	0	2	1	1	0	100
19	95	1	0	3	0	0	1	100
20	100	0	0	0	0	0	0	99
21	54	2	6	10	8	7	12	99
22	40	17	9	10	18	1	4	99
23	65	14	7	9	2	1	1	99
24	61	9	5	6	16	3	0	100
25	96	1	0	1	0	0	0	98
26	61	21	4	7	5	0	2	100
27	65	2	3	15	11	1	2	99
28	69	15	1	1	10	2	1	99
29	66	7	3	6	8	7	2	99
30	99	0	0	0	0	0	1	100
31	100	0	0	0	0	0	0	100
32	74	11	1	12	1	0	0	99
33	99	1	0	0	0	0	0	100
Grand Total	2480	164	101	152	147	70	63	3177
Percent of Total	78	5	3	5	5	2	2	100

Table 1. Summary of the ground evaluation of the slash pine study plots established by Hudson Pulp and Paper Company in Flaggler and Volusia Counties, Florida. Infection levels recorded during April 1978 were rated in the following categories: (1) Healthy (2)-(6) Dieback expressed; (2) 1-3 laterals, (3) Terminal only; (4) Terminal + 1-3 laterals, (5) Terminal + less than ½ crown; (6) Terminal + more than ½ crown; and (7) Dead.

difficulty of locating and identifying single affected branches in the tree crown. Where most of the crown was affected it was possible to identify diseased trees. However, tree crowns with early stage (branch tip) or low level infections were inseparable from healthy crowns in the photographs.

Discussion:

At this point in time we must consider that the results of this aerial photo application were unsatisfactory. While some of the photographs contained image motion the main problem appears to be scale. 1:2000 is too small a scale to allow detection of past year branch kill (grey needled dead branches) or current year flagging.

Infra red photography at a scale of 1:3200 was also unsatisfactory. While full crown involvement was discernable, isolated branches or branch tips were difficult (or impossible) to locate, primarily due to the small size of a branch reduced 3200 times.

The areas which were photographed (Volusia and Flagler Counties), were selected based on reports of heavy pitch canker damage. It would appear, from the small number of red flagged trees, that current season infection was at a very low level. As a consequence, anything which is said about photographic identification of reds and faders is still tentative.

From the photographs we were able to locate trees which had red crowns and even trees with as few as two red branches. However, two trees recorded as having 1-3 red laterals were not located on the photos. The problem is known to be the orientation of the camera with respect to the red branches. In both cases, healthy branches between the camera and the red branches completely masked these symptomatic branches. No economically feasible

modification of the technique employed will overcome this artifact of position.

While it is felt that the results of this photo mission were not satisfactory as a tool for detection of pitch canker, we are not, as yet, ready to abandon the technique. Attempts must be made to generate stereo pairs at an even larger scale (1:1200 or 1:1000). The utilization of a longer focal length lens should reduce the parallax problems which we encounter with our current large scale photography. Observation of fine branches within the crown should then be possible.

The results of the infra red photography were slightly more useful (despite the small scale of the photos). Color shift recorded by the infra red film is greater than in true color photography and, as such, complemented the ability of the photo interpreter.

Further tests should be made in an attempt to determine a practical, economical method of aerial photography for the detection and evaluation of pitch canker. Recommendations for these future tests include; use of a longer focal length lens (12 inch), increase scale to 1:1200 to 1:1000 generating stereo pairs in infra red rather than in true color and consider other photographic systems.

Good results have been obtained using a 70 mm camera system to generate photography at scales of 1:1584 and 1:792 (Croxton,1966; Houston,1972). Attempts should be made to determine if either of these larger scales would provide satisfactory images for the location of and evaluation of pitch

canker affected trees. Both true color and infra red imagery generated by a Hulcher-70 or some similar photographic system ought to be evaluated.

One caution must be included. If a satisfactory combination of camera/film/scale/lens can be identified, our results indicate that the utility of the photography must be tied to a sampling procedure since large scale photography would be prohibitively expensive over large areas of forested trees.

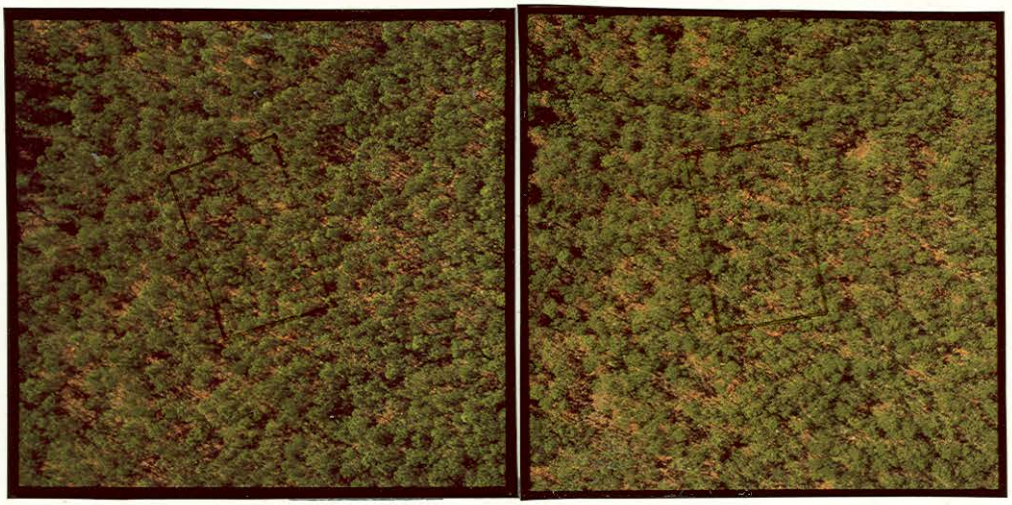
Figure 1: Slash pine showing early branch symptoms; red coloration of the topmost needles on two lateral branches. To suggest the photographic reduction, the pictured terminals are reduced approximately 1:20. Reduced to a scale of 1:2000 8" needles become .004". Even assuming the needles are spread perfectly opposite each other the resulting spot would only be .008" (or approximately 1/100") in diameter.

B

A

Figure 2. Later stages in the progression of pitch canker infection. Terminal needles are lost and needles further down the leaders are now browning. The effective size of this damage at 1:2000 (as in Figure 1) will still be in the approximate range of 1/100 of an inch.

Figure 3: Late (pre-death) stage of pitch canker disease etilogy. Full crown involvement is to be seen; terminal and all laterals are affected. At this stage the entire area occupied by the crown is now effectively identifiable. In this stage the effective area of a tree crown 4' in diameter at a scale of 1:2000 will appear to be .024". A more realistic 15' in diameter crown will still only show at approximately .1 inch diameter.



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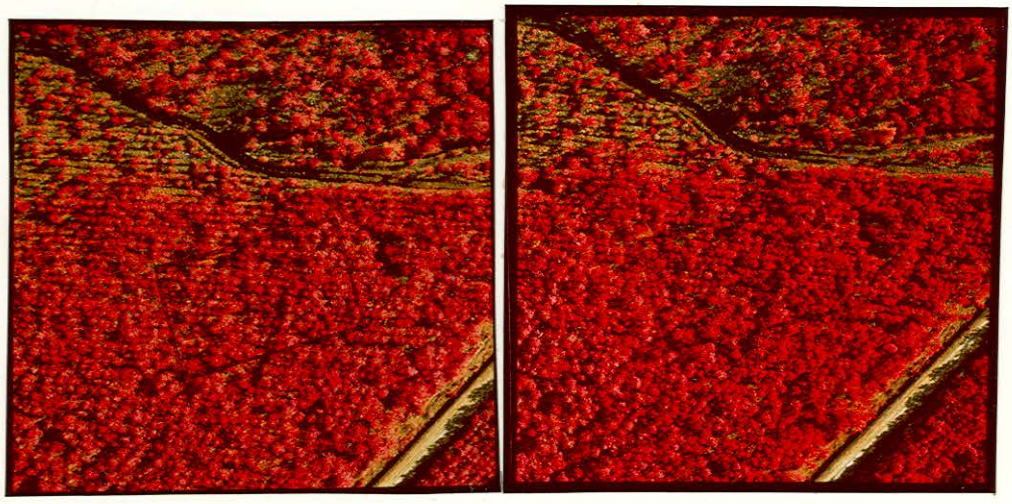

B

Figure 4. Cibrachrome prints of first generation transparancies taken of plots in heavily pitch cankered slash pine plantations. Pair A shows plot #2 (see Table 1), actual scale 1:2000, photographed with aerocolor transparency film. Pair B shows plot #22 (see Table 1), actual scale 1:3500, photographed with infra red transparency film. Neither format is satisfactory for evaluating the incidence of pitch canker (see discussion).

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